B38RO Introduction to Robotics

COURSE DETAILS
Course Code: B38RO
Full Course Title: Introduction to Robotics
SCQF Level: 8
SCAF Credits: 15
Available as Elective: No

DELIVERY LEVEL
Undergraduate: Yes | Postgraduate Taught: No | Postgraduate Research: No

Additional Information:
<p>Course being delivered at the specified campus(es) and also by Collaborative Partner - Ocean University of China on BEng Robotics Programme.</p>

COURSE AIMS

Understand fundamental concepts of robot kinematics.

Understand concepts of links, joints, end-effector, and environment for robotic systems.

Gain proficiency in applying reference frames and transformations in robotic systems.

Understand forward and inverse kinematics and gain proficiency in computing these in robotic systems.

Understand fundamental concepts of robot dynamics.

Understand the concepts of force, torque, and inertia matrix relations for robotic systems.

Gain proficiency in applying Newton Equations for translational and rotational movements in robotic systems.

Apply the knowledge of robot kinematics and dynamics to a simple robot manipulator system.

Gain exposure to the concepts of trajectory planning, robot control, force/torque sensing, and robot vision in the context of robot kinematics and dynamics.

LEARNING OUTCOMES – SUBJECT MASTERY

EA2i Ability to apply the reference frames, transformation matrices, translation and rotation relations to robotic systems using the Denavit-Hartenberg convention.
**B38RO Introduction to Robotics**

**EA4i** Ability to perform the overall forward and inverse kinematics analysis of robotic systems using the above mentioned techniques.

**EA3p** Ability to apply computational methods with mathematical software tools and robot simulators in order to simulate forward and inverse kinematics and related robot movement.

**EA4p** Understanding of, and the ability to analyse a given robotic system in order to establish relations between joint and end-effector movements through forward and inverse kinematic solutions.

**EA2i** Ability to apply the Newton-Euler Equations for force and torque interactions of joints of a simple robotic systems.

**EA4i** Ability to perform the overall forward and inverse dynamics analysis of a simple robotic system using equations of individual joint interactions.

**EA3p** Ability to apply computational methods with mathematical software tools in order to simulate joint torque/force, end-effector force/torque and robot links motion for simple robotic systems.

EA4p Understanding of, and the ability to analyse a given robotic system in order to establish relations between joint torques, robot motion, and interaction of end-effector with environment for simple robotic systems.

**EP3p P2** Ability to apply the learned concepts of kinematics and dynamics analysis on simulations with computational programs (MATLAB) and virtual robot simulation and experimentation platforms (e.g. VREP).

**LEARNING OUTCOMES – PERSONAL ABILITIES**

Develop skills to apply kinematics and dynamics analysis techniques to robotic systems.

Develop skills to simulate the kinematics and dynamics relations of robotic systems.

**SYLLABUS**

1) Robot Arm Kinematics (5 weeks=15 hours lecture, 5 hours tutorial)

i) Reference frames
B38RO Introduction to Robotics

ii) Rotations and transformations
iii) DH Convention and Parameters
iv) Forward Kinematics
v) Inverse Kinematics

2) Robot Arm Dynamics (5 weeks=15 hours lecture, 5 hours tutorial)
i) Newton Equations applied to translations and rotations
ii) Inertia matrix computation
iv) Newton-Euler Formulation of Robot Dynamics
v) Lagrange-Euler Formulation of Robot Dynamics

3) Complementary Topics in Brief (1 week=3 hours lecture, 1 hour tutorial)
i) Trajectory Planning
ii) Control of Manipulators (computed Torque Control)
iii) Force/Torque and Touch Sensors
iv) Robot Vision

LOCATION AND ASSESSMENT METHODS

<table>
<thead>
<tr>
<th>Method</th>
<th>Weight</th>
<th>Exam Mins</th>
<th>Type</th>
<th>Diet</th>
<th>Synoptic Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination</td>
<td>60</td>
<td>120</td>
<td>Assessment</td>
<td>Semester 2</td>
<td></td>
</tr>
<tr>
<td>Coursework</td>
<td>40</td>
<td></td>
<td>Assessment</td>
<td>Semester 2</td>
<td></td>
</tr>
<tr>
<td>Examination</td>
<td>100</td>
<td>120</td>
<td>Reassessment</td>
<td>Semester 3</td>
<td></td>
</tr>
</tbody>
</table>